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ABSTRACT

The testing effect is a phenomenon that may be described as follows: following the reading of a prose passage, a group of students who are given a posttest on the passage immediately or shortly afterward will later recall more of the passage on a retention test than will a similar group of students who are not given the posttest. Testing as a means of directly enhancing prose learning is generally not recognized and is not used much in the schools. If it were, every period of instruction would be brought to a close with a short test. Such a test could well be an ungraded self-test, for its purpose would be not to manage the instructional process, but to consolidate the learning experience that has just taken place. Testing in this sense is similar to practice or rehearsal. The testing effect consolidates learning in terms of degree of processing, not structurally. A test thus provides a stimulus for engaging in the consolidation of learning. The context here is similar to that of most adjunct aids, such as learning objectives, inserted questions, and typographical cueing, all of which suggest certain strategies to the learners. Research on the testing effect has generally excluded, for experimental reasons, the provisions of feedback, review opportunities, and test anticipation effects, in order to isolate the consolidation effect per se. However, all of these other factors would likely be present in educational contexts and would further add to the value of testing. (HOD)

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TESTING TO AID TEXT PROCESSING

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Taking a test over a passage one has just studied can greatly increase later recall of information from the passage (on a delayed retention test), even without feedback or further review of the passage. This important phenomenon, known as the testing effect, is analyzed in this paper for both its practical instructional implications and for its theoretical ones related to text processing. The cognitive process involved in this phenomenon is called consolidation. Also considered is the relationship of this effect with the effects of adjunct questions in text (mathemagenics). The applicability of each type of processing aid to practical instructional situations is examined. The analysis concludes with a view of text processing which emphasizes text in its instructional setting.

INTRODUCTION

A well established phenomenon, although one which is not currently accorded much interest, is the effect of post-testing on the retention of prose (Gates, 1917; Spitzer, 1939). This effect is described as follows: following the learning of a prose passage, a group of students who are given a post-test on the passage immediately or shortly afterwards will later recall more of the passage on a retention test than will a similar group of students who are not given the initial post-test. This effect, obtained without any feedback being given to the students, can be quite remarkable,

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leading at times to a doubling of the retention scores for the post-tested group (e.g., Jones, 1923-24; Duchastel, 1979a).

This testing effect can be considered from two distinct perspectives. On the one hand, it is useful to ask what practical implications can be derived from the phenomenon for teaching practice. And at a more fundamental level, it is useful to consider the phenomenon within a theoretical framework and speculate about both the mental processes involved and the instructional strategies which are possible.

This paper is concerned with both practical and theoretical considerations. It does not present new empirical evidence in the matter, nor does it review literature in depth; it attempts rather to give perspective to the testing effect by examining it within the contexts of education, psychology and text processing. Specific research results can be sought out by the interested reader by examining some of the titles listed in the reference section. Unfortunately, there exists to date no comprehensive review of the literature in this interesting area of research.

PRACTICAL IMPLICATIONS

In educational practice, testing a student's knowledge of a piece of written material which was assigned is usually considered as an exercise in assessment, i.e., as one of evaluating the degree to which the student has mastered the content of the reading. There is a second function of testing which is also generally recognized: that of enabling the student to diagnose his errors or lack of knowledge and, through feedback, to improve his grasp of the subject. This latter function concerns in reality a direct learning effect: the information which is provided through feedback amends or adds to the student's initial knowledge of the assigned reading material.

Both of these functions view testing as a means of obtaining information

which indicates the status of a student's grasp of some body of content. The student's knowledge is assessed, and this in turn informs the management of subsequent learning and teaching activities.

These functions of assessment are important and well recognized in education. They are however only part of the picture of testing. Testing as a means of directly enhancing prose learning is generally not recognized, and not much made use of in the schools. If it were, every period of instruction, every university lecture would be brought to a close with a short test. Such a test could well be an ungraded self-test, for its purpose is not primarily to manage the instructional process, but to consolidate the learning experience which has just taken place.

Testing in this sense is similar to practice or rehearsal. Every teacher recognizes the value of practice for developing skills (be they motor skills, such as typing, or intellectual skills, such as algebra). Every teacher also recognizes the value of rehearsal when rote verbal learning is involved, such as in learning a poem or the capitals of Europe. Practice is also recognized as important in areas of application, for instance in applying principles of social psychology to actual situations, or statistical methods to research problems. When it comes to meaningful learning however, as say in studying introductory psychology, German literature, philosophy and so on, practice is generally not considered essential. The emphasis is on comprehension, rather than on retention. It is assumed that proper comprehension leads inevitably to good retention. One consequence of the research on the testing effect however is an awareness that testing can greatly facilitate learning in the area of meaningful learning as well. Of particular relevance for this symposium is the fact that textual materials generally fall within this area.

To sum up, research on the testing effect suggests that all instruction, including the teaching of abstract ideas, should conclude with a brief test, the purpose of which is not primarily to assess learning but to consolidate it. This is a suggestion which is eminently practical, in the sense that it is relatively easy to implement (since no grading need be involved) and it could be done immediately. An essential requirement however is a realization on the part of educators that testing is not solely a means of assessment, but also a means of assisting learning.

THEORETICAL CONSIDERATIONS

The term consolidation has already been used a few times in discussing the testing effect in this paper. Consolidation would seem to be the preferred term for the phenomenon, but it does need some explanation, so I now turn to an examination of the phenomenon from a theoretical perspective. The discussion remains nevertheless couched within an educational framework, for we are considering a very practical phenomenon which can be applied to instruction and text learning.

The term consolidation is used to identify the underlying psychological process because it is the act of retrieving information from memory which enhances later retention of what was initially processed. Let me speculate on what happens. A student reads a text and builds up a representation of the information being communicated. Within this representation, individual elements are encoded to a greater or lesser extent depending on a large number of factors. By encoded, I mean that the information is fixed into memory. But memory is not a rigid on-off affair, it involves a question of degree. An element of knowledge is more or less well learned and will be more or less memorable later on.

After having studied the text then, our student has a memory of its elements

which is more or less robust. If he then attempts a test, our student further processes these elements of information, thus fixing them a little more in memory and making them more resistant to forgetting. He in effect consolidates his position with respect to these memories before going on to something else. A parallel can be drawn here to the theoretical notion of depth of processing, by which information is learned and remembered to the extent of the attention and elaboration given to it by the learner during text processing (see Duchastel, 1981, for qualifications on this parallel).

The term consolidation is borrowed from the field of physiological psychology. There, it refers to a similar but distinct phenomenon: learning followed by a period of mental rest leads to better retention than learning followed by further mental activity. In this sense, learning needs time to seep in, so to speak. In testing of course, we are not providing inactivity, but more activity, more processing of the same material. The parallel in this instance lies in the provision of an occasion to follow learning with a situation which will help fix that learning in memory. This view of the phenomenon ties in nicely of course with the interference theory of memory.

However, the term consolidation also has another meaning, one which is not appropriate here. Indeed, the term can have a structural connotation of relating elements together (synthesis) as in the consolidation of one's stock holdings or the consolidation of an enterprise. The equivalent in text learning would be the consolidating of one's representation of a topic, as summaries are meant to do for instance. It is likely that certain types of questions on a test might well assist learning in this way, but that is a different phenomenon altogether. The testing effect consolidates learning not structurally, but in terms of degree of processing.

Other ways to characterize the process underlying the testing effect might be in terms of mental review, or rehearsal, or simply practice. These would all be adequate substitutes for consolidation but the term consolidation is preferred for practical reasons. It would probably be difficult to convince teachers that a chapter in a sociology text, for instance, needs to be practiced or rehearsed, for these terms are associated with skill development and rote learning. Mental review might be more acceptable, but associated with that term is the idea of a cursory overview demanding rather little mental effort.

It is useful at this point to move away from learning theory and into the wider framework of instructional theory. The provision of a test following learning is an occasion for further processing of the text contents which were just learned. In this sense, a test is an explicit instructional device for getting the student to do something which he might not do otherwise. Some students do undoubtedly engage in self-testing after studying a text chapter, but more likely, most do not. A test, whether given by the teacher or simply presented as a set of end-of-chapter questions, provides a stimulus for engaging in the consolidation of learning. The context here is similar to that of most adjunct aids, such as learning objectives, inserted questions, typographical cueing, etc., all of which suggest certain strategies to the learner.

It is profitable to contrast testing with certain other instructional means which might be used to enhance text processing. First, is providing a test more advantageous than simply asking students to spend extra time in reviewing the text on their own? The answer is yes (Nungester and Duchastel, in press) and it is easy to see why: testing provides a challenge to the student and furthermore provides a framework for further processing. Review in contrast is generally unexciting and unfocused.

What about testing versus the provision of inserted questions? Inserted questions do consolidate learning and they may even be more effective at this than end-of-chapter questions since the relevant text section being questioned was read more recently; the information in memory is thus more available and hence more consolidatible. It should be noted in this respect that if a student cannot answer a question, no consolidation will occur. It is also easier with inserted questions for a student to go back and search the text for an answer if he cannot answer the question at first.

It is furthermore claimed that inserted questions can increase the depth of text processing generally, with effects on information which is not questioned about (enhancement of incidental learning). There may be some value in this view, but such enhancement is either unlikely or at any rate rather minimal. The research on incidental learning from inserted questions is mostly inapplicable to practical text learning situations, as has been argued in detail elsewhere (Duchastel, 1979b).

On the whole then, it would intuitively seem that inserted questions might be preferable to end-of-chapter questions or to a post-test. Testing however has the advantage of greater simplicity. A publisher can incorporate inserted questions in a text, but a teacher cannot. A teacher can however easily prepare a test and provide it to his students. Thus, inserted questions might be better on theoretical grounds, but probably not so in practice.

CONCLUDING REMARKS

There remains much to be explored with respect to the testing effect. For instance, are short-answer questions preferable for retention to multiple-choice questions? Recent research on this issue has had ambiguous results (Duchastel, 1980; Duchastel and Nungester, in press). And of course, the

practical possibilities for making use of the phenomenon in educational settings need much further consideration. Research on the testing effect has generally excluded, for experimental reasons, the provision of feedback, of review opportunities and test anticipation effects, in order to isolate the consolidation effect per se. However, all of these other factors would likely be present in educational contexts and would probably further add to the value of testing.

I would like to conclude by moving up a notch in abstraction to examine adjunct aids and text processing more generally. As instructional researchers, we usually consider text as straight prose. To this prose are then added various adjunct aids such as questions, objectives, underlining and so on, and we seek to determine whether these devices assist learning or not. This is a laboratory-based view of the world and not necessarily an unreasonable one, although it can be, as much of the research on inserted questions demonstrates.

In educational settings, it might be preferable to view a text as a complete entity comprising both a basic discourse (the content) and a supra-discourse structure (the processing environment, including adjunct aids). Macdonald-Ross and Waller (1975) argue this case most convincingly. Two reasons motivate this view. One reason is that text is a very malleable form of communication, and the distinction between text and adjunct aids can be a rather fuzzy one. An advance organizer, for instance, is usually considered as an adjunct aid, but in practice it would likely simply be incorporated into a text (as a special introductory section of a chapter, for instance). More importantly, as text research has taken a definite turn toward text processing, what becomes interesting is not so much the abstract value of individual devices or individual processes, but rather the global process of learning from text. The recent interest in comprehension monitoring,

for instance, is indicative of this trend. To text processing in the narrow sense is added the interesting and relevant domain of text usage, i.e., study strategies. In this context, text research is no longer concerned with brief experimental passages, but with full-fledged chapters from textbooks. Text processing is no longer studied in artificial situations, but in ones which realistically mirror educational settings. This context of course remains an ideal, but one which can guide more constrained attempts at understanding text processing.

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